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Emergence Period of Black Hills Beetles from Ponderosa Pine in the Central Rocky Mountains

W. F. McCambridge[1]

Control of Black Hills beetles (Dendroctonus ponderosae Hopkins) in ponderosa pine (Pinus ponderosa Lawson) is geared to the period when the beetle is not in emergence and flight. Control measures must be completed by the time the emergence period starts. Following emergence, a new survey may be needed to determine the success of the control work and locate the centers of infestations for possible mopup control the following season.

Emergence data available for 5 years from four areas in Colorado (table 1) were analyzed to determine when beetles start to emerge and control must cease, and when emergence is completed and operational surveys can start.

Emergence Patterns

Although there was considerable variation from year to year, the emergence patterns for the 5 years, plus an average emergence curve combining data for 1937, 1938, 1962, and 1963 (fig. 1) show the general similarity in the rate and time of emergence.

Emergence normally begins about July 15. For about 20 days, emergence proceeds slowly and erratically during which time approximately 5 percent of the beetles emerge. Then emergence is rapid, hitting a peak about August 20 when almost 50 percent of the beetles have emerged. By the end of August, approximately 90 percent of the beetles have emerged, and it is unlikely that further attacks will be made on uninfested trees. Random chance reveals that 1 year in every 5 the beetles will emerge up to 2 weeks earlier than average.

Temperature Records

The time of emergence appears to be related to temperatures during the periods of beetle development--August, September, and October, and the following May, June, and July. The early emergence that occurred in 1939 probably was due to exceptionally warm weather which prevailed during the development period. Conversely, emergence in 1937 and 1962 would be expected to be later than normal. In that regard, emergence in 1962 appears out of line. Perhaps the temperature records, which were taken at the District Ranger's weather station in Bailey, are not

[1]*Entomologist, Rocky Mountain Forest and Range Experiment Station, with central headquarters maintained at Fort Collins in cooperation with Colorado State University.*

49 1--411/414

Table 1.--Data on emergence of Black Hills beetles from ponderosa pine at four locations in Colorado, 1937-39,[1] 1962-63[2]

Year	Colorado location	Elevation	Date cages installed	Cages	Bark area caged	Average beetle emergence	Sum of average temperature departures from normal	
							6-month period[3]	3-month period[4]
				Number	Sq. ft.	Per sq. ft.	Degrees F.	
1937	Evergreen	7,300	July 19	40	80	28.0	-8.8	-2.9
1938	Estes Park	8,000	Before July 11	20	40	21.5	+3.4	+9.0
1939	Estes Park	8,000	Before June 26	15	66	27.3	+10.3	+8.7
1962	Bailey	8,400	July 14	6	42	45.6	-6.9	-5.9
1963	Allens Park	8,500	July 10	10	60	21.6	+4.2	+.3

[1] From unpublished reports filed at Rocky Mountain Forest and Range Experiment Station, Fort Colorado:

Beal, J. A., and DeLeon, Donald. A study of the Black Hills beetle in southeastern Wyoming and central Colorado, summer of 1937. May 16, 1938.

DeLeon, Donald. The biology and control of the Black Hills beetle, summary of studies in Colorado and Wyoming, 1935-1938. May 13, 1939.

DeLeon, Donald. Summary of 1939 Black Hills beetle studies, Colorado and southern Wyoming. February 26, 1940.

[2] From information collected by McCambridge.

[3] August, September, October of year of beetle attack, plus May, June, July of following year (year of emergence).

[4] August, September, October of year of beetle attack.

well related to the temperatures on the emergence plot which is 400-500 feet higher, and on a warm, south-facing slope.

If higher than normal fall and spring temperatures were responsible for the early emergence in 1939, weather records[2] show that early emergence would also have occurred an additional eight times between 1924 and 1963 in the Estes Park area, and three times within that period in the vicinity of Bailey. Excess temperatures during the fall only occurred four times near Estes Park and once near Bailey.

Emergence Cages

Until reliable clues such as temperature are available for predicting the emergence period more precisely, screen cages (figs. 2, 3) can be used for determining whether to extend the control season in the normal years. Cages should be installed early in June for two reasons: to detect start of emergence, and to prevent a false emergence which might occur if the beetles are disturbed when the cages are attached to the trees or when the bolts are cut from the infested trees.

Since beetles emerge from individual trees at different times, enough cages should be installed to accurately determine the start of emergence. Analysis of emergence data from the Bailey Ranger District, Pike National Forest, showed that the start of emergence could be determined 9 times out of 10 if 20 cages were installed throughout the District (approximately 100,000 acres).

Cages should be installed on trees (fig. 2) or on bolts (fig. 3) of densely infested portions of trees of average diameter growing under typical conditions of elevation and exposure. Even though emergence from the

[2] *Average monthly maximum and minimum temperatures taken from: U. S. Weather Bureau. Climatological Data, Colorado. Jan. 1, 1924 - Dec. 31, 1963.*

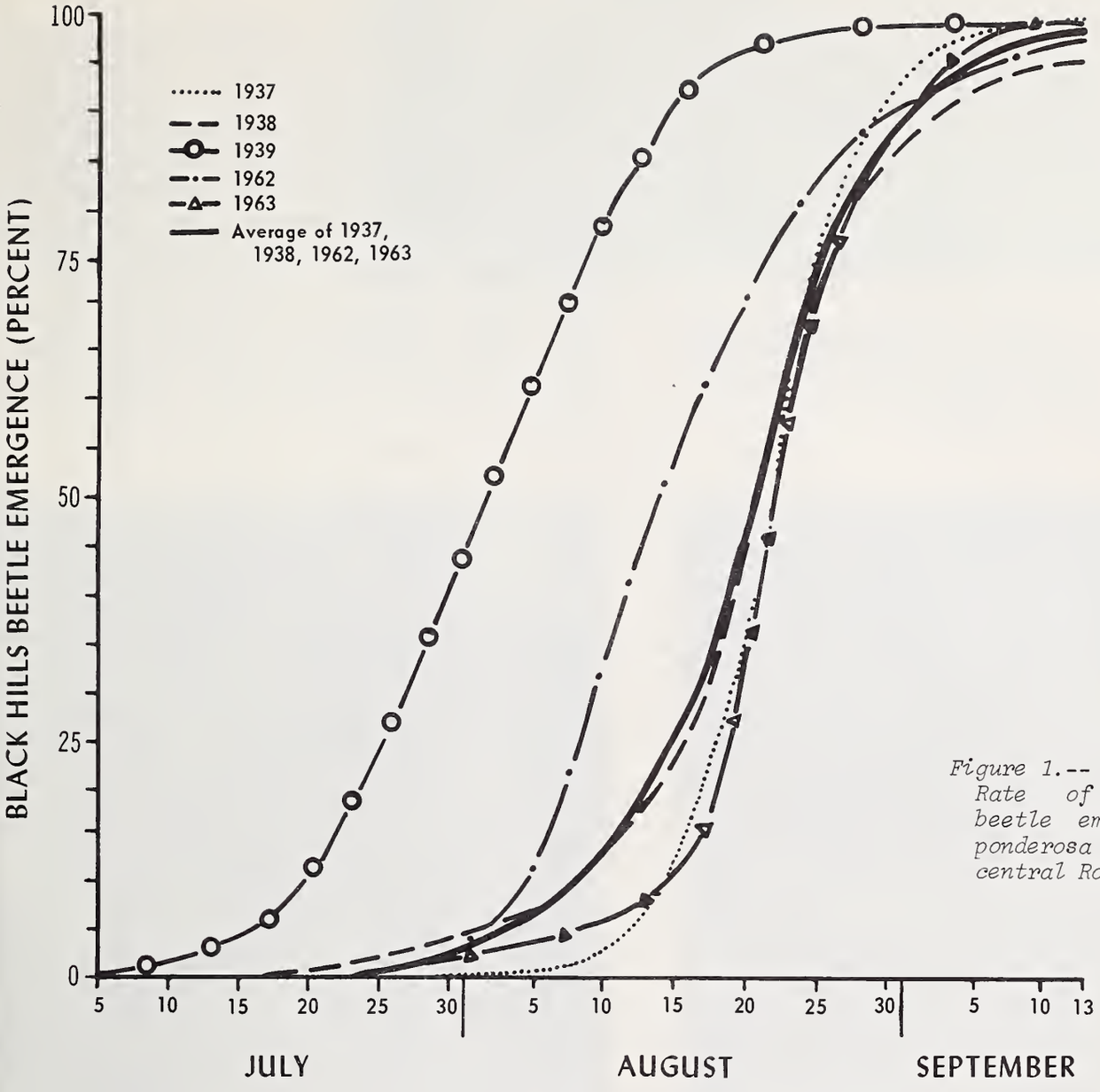

Figure 1.-- Rate of Black Hills beetle emergence from ponderosa pine in the central Rocky Mountains.

north and south sides of the trees takes place contemporaneously, cages installed on trees should be placed on the north side where beetle survival and emergence are significantly greater.

To determine whether a tree is adequately infested, a bark sample about 4 by 6 inches should be taken from each side of the area to be caged or from each end of the section from which a bolt is to be cut to observe density of beetle populations. The fact that a tree is a fader or sorrel-top is not sufficient evidence that the tree is heavily infested. If each sample section has three or more Black Hills beetle pupae or adults, the tree is adequately infested to serve as a cage tree.

The bolt cages may prove to be the more efficient. This will be true if bolt cages assembled at one place will yield reliable emergence data. Care should be used to locate the cages under conditions comparable to the area from which the bolts were cut.

Control Plans

Control projects should always be planned for completion by July 15. Most years, the control season can be extended to August 1, but the only way to be sure whether the beetles have started to emerge is careful observation of the emergence cages. If emergence is average, the control project can continue

to August 1, with operational surveys to start after Labor Day. These surveys are to appraise the success of the control project and determine the need for mopup control.

Beetle Development

A brief description of beetle development prior to emergence may be helpful in appraising the advent of emergence.

In May, pupae are common and are found in individual pupal chambers. These pupae transform to light-colored adults in late May and early June. The young adults soon darken, and by late June most of them appear mature. By early July the beetles begin to assemble in small groups under the bark, and some will be found boring exit tunnels into the outer bark. The presence of these partially completed exit tunnels in early July does not mean that emergence is imminent. Under normal conditions, emergence begins about July 15.

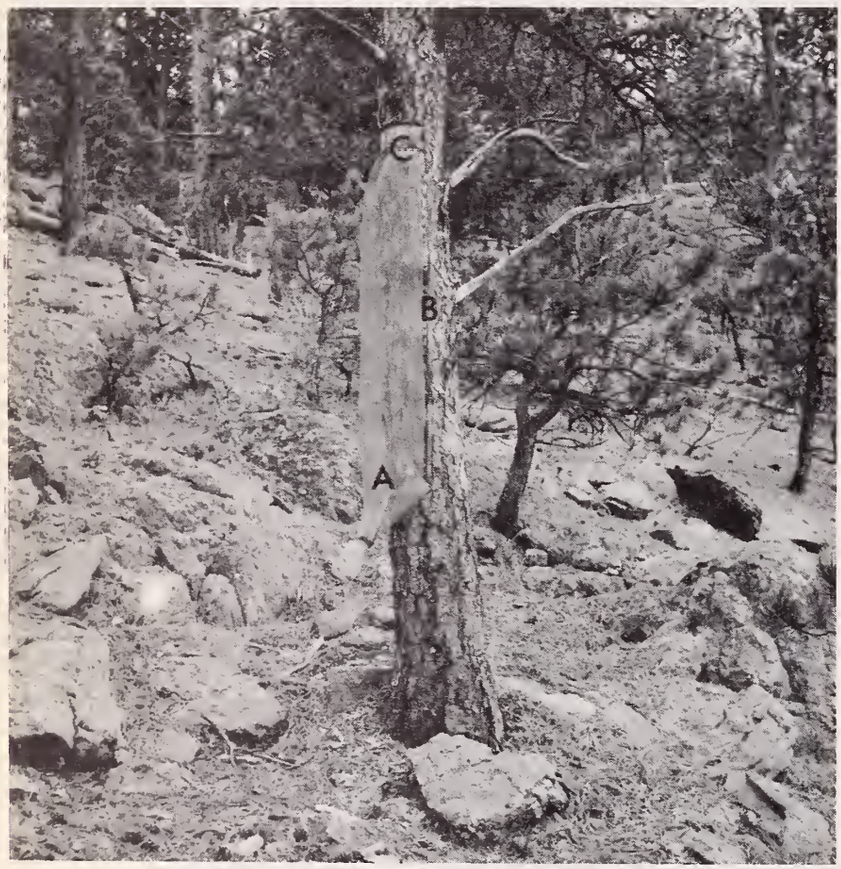

Figure 2.--
Tree emergence cage, approximately 18 inches wide by 48 inches long, tacked to wood after bark has been shaved smooth around the edges. With the cage folded backward inside edge A is attached first, then edges B, B[1] (not shown), and C. Pint Mason jar is adequate for beetle recovery; regular window screening is used.

Figure 3.--
Cylinder cage, approximately 15 inches in diameter by 36 inches long, including the funnel. Infested bolt is secured by an eye hook, A, through 3/4-inch plywood disk, B, at top of cage. Screen is stapled to plywood and soldered along side. Funnel screen is held by solder, C; regular window screening is used.